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special organs, and the latter including those types in which we have such special structures in the form of contractile vesicles, nuclei, or other differentiated appendages. So far as the structure of the sarcode is concerned, Bathybius is apparently a true Monera, and such its discoverer considers it to be. At the same time, the existence in connection with it of Coccoliths and Cyatholiths indicates the necessity for separating it from Hæckel's other Monera, which have no such special appendages. But the time has not arrived for determining the absolute relations of these objects. New types, as Hæckel himself admits, are being discovered, rendering modifications of his groups necessary. Meanwhile there can be no question that Bathybius is the lowest of those known Protozoa, which, like the Foraminifera, secrete calcareous elements. Remembering the extent to which the sarcode is diffused through the mud of the Atlantic, there appears much that is suggestive and important in the observation of Dr. Carpenter, that, had its power of secreting a calcareous framework been somewhat increased, so that instead of detached structures in the form of Coccoliths, etc., it had produced a continuous calcareous mass, it would have given us a living prototype of the Laurentian Eozoon. The discovery of this widely and continuously diffused Bathybius strongly sustains Dr. Carpenter in his conviction of the animal origin of that primæval structure.—*Popular Science Review*, October, 1869.

REVIEWS.

RESULTS OF DEEP SEA DREDGING BETWEEN CUBA AND FLORIDA.*—Mr. A. Agassiz makes a "Preliminary Report on Echini and Starfishes Dredged in Deep Water." Part 1st is devoted to descriptions of new genera and

* Bulletin of the Museum of Comparative Zoology, No. 9, Preliminary Report on the Echini and Starfishes Dredged in Deep Water between Cuba and the Florida Reef, by L. F. de Pourtales, Ass't U. S. Coast Survey. Prepared by Alexander Agassiz, pp. 253-318.

new species. The second part is "On the Young Stages of Echini." The collections of Count Pourtales included many very young specimens. With these Mr. Agassiz has been able to study the young of thirty odd different species belonging to as many different genera. These observations seem to us so important and interesting that we give below a few extracts showing some of the general conclusions at which the author has arrived and the direction in which his labors are likely to affect the received ideas of the relations of the Echini amongst themselves.

"The changes some species undergo are so great that nothing would have been more natural than to place the two extremes of the series not only in different species, but often in different genera, and even in different families."

The different stages of growth of *Toxopneustes drobachiensis* Ag., represent in the younger stages *Cidaris*, then *Hemicidaris*, then *Pseudodiadema*, *Echinocidaris*, and *Heliocidaris*.

In *Cidaris*, *Diadema*, and *Garelia*, the changes are less marked, and in *Echinometra* they are greater than in any other genus of the regular Echini.

"We frequently find specimens of the same size, where in one case the outline is almost circular, the test flattened, covered with long slender spines, while in the other the test is lobed, swollen, high, surmounted by numerous short stout spines.

Among the Clypeastroids we find in the young during their growth great changes of form and structure taking place."

The transformations of *Mellita testudinata* and *Encope emarginata* are described as identical, whilst those of *Mellita testudinata* and *Mellita hexapora* are not so much alike, although both of the same genus.

"The development of *Stolonocypus prostratus*, and flat Clypeastroids of the type of *Clypeaster placunarius* is most instructive, tending to show that in connection with the development of the Scutellidæ above described, we must probably introduce a complete reform among the genera recognized as *Lemtia*, *Scutellina*, *Runa*, *Echinocyamus* and other minute Echinoids, which may eventually prove to be nothing but the young of other Clypeastroids, as *Mellita*, *Scutella*, *Laganum*, *Stolonocypus*, *Clypeaster*, *Encope*, and the like; but want of sufficient material prevents me from entering into this comparison more in detail. Though we know now, from what has been said above, that the Scutellidæ pass through phases which cannot be distinguished from *Moulinia*, *Fibularia*, *Runa*, *Scutellina*, and the Clypeastroids proper pass, as I shall show below, through a stage of growth identical with *Echinocyamus*."

"The development of *Echinolampas* has thrown unexpected light upon the affinities of the toothless *Galerites* and of the *Cassidulidæ*. It shows conclusively that *Echinoneus* is only a permanent embryonic stage of *Echinolampas*, thus becoming allied to the *Cassidulidæ*, and that it has nothing in common with the *Galerites* as I would limit them, confining them entirely to the group provided with teeth."

This part of the work is full of important observations giving detailed descriptions of the development of the species in support of the general propositions a few of which we have quoted above.

Part No. III. is on their Bathymetrical and Geographical Distribution. Here Mr. Agassiz reaches a most important and interesting conclusion. He concludes, from a specimen of *Ananchytes*, probably *Ananchytes radiata* found on the Isthmus of Panama, that the Pacific and Gulf of Mexico were united during the Cretaceous period, and have since been separated by the gradual rise of the land. This rising of the Isthmus, separating first the deep sea Cretaceous forms, then those of the next zone, which Mr. Agassiz says are "representatively of Tertiary genera," and finally dividing the littoral species which are now represented by numerous

closely allied or identical species. The fact that we are now to look for zones of life in which the genera are representative of former geological ages from the Cretaceous upwards, according to their depth, if true, is not less interesting than Professor Forbes' original discovery of the bathymetrical distribution of marine forms. The investigators of the two faunæ have generally speaking agreed either in considering some of the species in their different branches of research as identical, or very closely allied, although found on different sides of the Isthmus. Prof. Verrill, however, at the last meeting of the American Association, showed that the massive reef building corals of the Atlantic side were, with the exception of the genus *Porites*, wholly wanting on the Pacific, a difference which could not be accounted for if there had been any very wide channel communicating between the two oceans since the existing species came into being.

Mr. Duncan, from his investigations in his article "On the Fossil Corals of the West Indian Islands,"* is disposed to admit the connection of the two oceans during the Tertiary Period and this upon the grounds that genera resembling the present Indo-Pacific forms predominated in the Tertiary formation over those which are allied to genera now existing in the Caribbean seas, and Mr. J. C. Morsé,† who has examined the fossil shells of San Domingo, confirms this view so far as to admit that Tertiary species like those now living in the Pacific are found in the rocks of that island.

It would appear, therefore, from these conclusions, and those reached by Mr. Agassiz and Professor Verrill, that the connection of the faunæ must have been much more general in former geological periods, and that Indo-Pacific species actually did at one time cross their present boundaries and encroach upon the Atlantic, although subsequently driven back to their original limits.

The absolute identity of existing species of fishes common to both shores of Central America; and the similar physical conditions under which they exist, as pointed out by Dr. Günther,‡ forms another element in this curious problem.

If the developmental hypothesis is adopted, how shall we account for some species varying so as to become representative of each other after being separated for some time and others remaining invariably the same?

If some departed from their original types either by the direct action of physical causes or through natural selection, why did others, closely allied to them anatomically, remain unchanged? Why do we not have in the fresh-water lakes of Managua and Nicaragua some forms such as the Crustaceans and fishes found in the fresh-water lakes of Sweden, which were formed by the rise of the lands now dividing the Baltic from the Arctic Ocean?

Why did the Pacific fauna retreat after the Tertiary period, leaving, as

* Quarterly Journal Geological Society of London, xix, 1863. † Ibid., 1856.

‡ Trans. Zool. Soc., London. VI, p. 397, 1868.

Mr. Lyman shows below, the Caribbean fauna in undisputed possession of the Atlantic side, with outlying species on the Pacific shores?

Do Cretaceous forms occupy the depths, and Tertiary genera the middle ground of the coast on the Pacific side, and if so, what are the relations of these facts to the geological history of North America?

These are a few of the questions which present themselves and which can only be answered by farther investigation.

The expedition of the English government, sent out during the past season, dredged at the enormous depth of two thousand four hundred fathoms (nearly the height of Mont Blanc) and brought up living organisms. Though our own expeditions have not obtained specimens from such deep soundings the results have been none the less interesting.

It was announced by Professor L. Agassiz at the last meeting of the American Association, that it was the intention of the Superintendent of the Coast Survey to carry out other lines of sounding from the Atlantic side and still others from the Pacific shore.

The enlightened spirit of appreciation for the present needs of science displayed in these expeditions of the Coast Survey, and the great importance of the results they have already attained, promise to accomplish as much for the progress of Natural History in this country as they have hitherto for that of Geography and the Physical History of the sea.

Part IV. contains a "List of Star-fishes, which, though ranging through depths of from five to one hundred and seventy-four fathoms, present an unexpected departure from what was offered in other dredgings."

"With the exception of the *Pteraster* and *Asteracanthion tenuispinum* the bathymetrical and geographical distribution of the star-fishes do not show any striking features."

Mr. Lyman's report* on the Ophiuridæ and Astrophytidæ shows that all the new types of these families are found only below one hundred fathoms. Seven of these new genera are described at length. Mr. Lyman's conclusions are confirmatory of those published by Mr. Agassiz; he, however, does not seem prepared to go quite so far.

In showing that there are obstacles in the way of the hypothesis that the Gulf of Mexico and the Pacific were joined by a strait across what is now the Isthmus of Panama, the author asks a very pertinent question. Why do we not find Pacific forms on the Caribbean side? The evidence all goes to show that there has been a migration of species from the Caribbean to the Pacific, but none from the Pacific to the Caribbean. This objection has already been partially answered, as we have remarked above, by investigations upon the Tertiary shells and corals of the West Indian Islands.

Count Pourtales' report† gives us a descriptive list of the Crinoids.

* No. 10, Bulletin of the Museum of Comparative Zoology. Report on the Ophiuridæ and Astrophytidæ dredged in deep water between Cuba and the Florida Reef, by L. F. de Pourtales, Assistant, U. S. Coast Survey. Prepared by Theodore Lyman. pp. 309-354.

† Bulletin of the Museum of Comparative Zoology, No. 11. List of Crinoids obtained on the Coast of Florida and Cuba, by the United States Coast Survey, Gulf Stream Expeditions, in 1867, 1868, 1869. By L. F. de Pourtales, Assistant, U. S. Coast Survey, pp. 355-358.

The late researches of Professor Sars upon the anatomy of this singular group has given it a preponderating interest to readers of these researches, and Count Pourtales' list shows that we may expect still greater additions to our knowledge. The author describes five new species of Antedon, and mentions that *Pentacrinus Müllerii* was found at a depth of two hundred and seventy fathoms off Havana, and at three hundred and fifteen fathoms off Double-headed Shot Keys, but not on the Florida side of the Gulf Stream.

Rhizocrinus Lofotensis has been obtained several times during the season of 1869, in depths varying from two hundred and thirty-seven to four hundred and fifty fathoms. The author also states that he has seen the collections of Professor Smith, made on the Josephine bank, a remarkable and almost precipitous elevation of the bed of the Atlantic, accidentally discovered by the Swedish Frigate Josephine between the coast of Portugal and the Azores. In this collection he saw *Rhizocrinus Lofotensis*, *Echinocucumis typica* and *Pteraster militaris*, species common to the coast of Norway and the deep sea fauna of the Gulf.

"The Holothurians * obtained in deep water off the Florida reef are few in number, and are very closely allied to, if not identical with, those of the deep sea fauna of Norway. The littoral species, so abundant on the reef, do not appear to extend into even moderate depths outside, at least they were never found in the dredge."

FOSSIL CRINOIDS OF OHIO AND KENTUCKY.†—This article comprises descriptions of thirteen new species and two new genera, *Hadrocrinus* and *Ataxiacrinus*. Mr. Lyon has passed some thirty years in perfecting the collection which forms the basis of his descriptions in the neighborhood of the Falls of the Ohio, and the thoroughness of his descriptions derive additional value for the interesting character of this locality. The new species belong respectively to genera, *Hadrocrinus*, *Actinocrinus*, *Cyathocrinus*, *Poteriocrinus*, *Platycrinus*, *Dolatocrinus*, *Ataxiacrinus*, and *Zeacrinus*.

MONOGRAPH OF THE PHASIANIDÆ.‡—Under this title Mr. Elliot, who is now in London, proposes to issue a companion work to his large and beautiful folio monographs of the "Grouse Family," the "Ant Thrushes," and his work on the "New and Heretofore Unfigured Birds of North America." The proposed work will contain figures, with accompanying text, of all the known species of Pheasants, Jungle Fowl, Turkeys, Pea Fowl, Guinea Fowl, etc. The plates will represent the species of life size and will be from original paintings by WOLF, lithographed by KEULEMANS and colored by hand. The monograph will be completed

* Bulletin of the Museum of Comparative Zoology, No. 12. List of Holothuridæ from the Deep Sea Dredgings of the United States Coast Survey. By L. F. de Pourtales, Assistant U. S. Coast Survey, pp. 359-361.

† Remarks on thirteen new species of Crinoidea from the Palæozoic Rocks of Indiana, Kentucky and Ohio; and a description of certain peculiarities in the structure of the columns of *Dolatocrinus*, and their attachment to the body of the animal. By Sydney S. Lyon. Transactions of Amer. Phil. Soc., Vol. 13, pp. 443-446, with two plates.

‡ By D. G. Elliot. Five parts, folio. Zoological Society, London.